

## Appendix D: Suitability Model and Project Prioritization

The Bicycle Suitability Model was developed to determine the most likely areas within the City of Chula Vista where cyclists are likely to ride to and come from. The model was created to prioritize areas and projects to benefit the largest number of cyclists possible. The Bicycle Suitability Model identifies existing and potential bicycle activity areas citywide utilizing existing data within an extensive GIS database.

### Bicycle Suitability Model

The overall model is comprised of three basic models: the Attractor, Generator and Detractor Models. When these three interim models are combined, they create the Bicycle Suitability Model. The model identifies the characteristics of each particular area in geographic space and assigns a numeric value for each of these characteristics. The score per area is then added to create a ranking for that particular area in geographic space.

### Cycling Attractor Model Methodology

The Bicycle Suitability Model identifies activity areas by utilizing cycling-related geographic features and conditions likely to attract cyclists. Typical bicycle commuter trips to nearby shopping centers, restaurants and work are very short, usually between two and five miles each way. As noted in survey responses, more avid cyclists can commute over 20 miles round trip. School age children will normally ride to school no more than a few miles round trip. The closer these attractors are to neighborhoods and primary cycling generators, the more conducive they are for trips by bike, and are therefore given a higher weighting score. A one mile maximum distance in the model was given to encompass the majority of the shorter bicycle trips. Many attractors are close enough to each other that they would overlap within the mile.

The point scoring for the given attractors was based on a multitude of cycling opportunities and bicycle amenities such as bicycle parking connections with other modes of transportation. For example, elementary schools are typically in neighborhoods to accommodate the younger population. Generally, a larger percentage of elementary school aged children rely on their bicycles as a mode of transportation to get to school compared to high school kids who are may hold a driver's license.

- a. The nine features used are schools, parks and recreation facilities, neighborhood and community retail, neighborhood and neighborhood civic facilities (e.g., post offices, libraries, major attractions and transit stations and stops).
- b. Points were assigned to several categories in each feature type, recognizing certain features were more likely to attract cyclists than other features.
- c. Once identified, network buffers were applied to each location using the GIS street database to simulate the actual street network and to develop an accurate distinction of cycling patterns. Each network buffer increases in distance from the feature's center point.
- d. Weighted distance values were assigned to each buffer. For example, a quarter mile network buffer is assigned a higher value than a half mile network buffer, since more people are likely to ride their bike to a destination a quarter of a mile away than half a mile.
- e. The values assigned to each feature type were multiplied by the weighted distance values for each network buffer.

- f. Each of the individual buffered feature types with their multiplied weighted values were overlaid on the city-wide cell grid.
- g. Within each cell, the features points were multiplied by the weighted values and then added to the other feature point scores with a resulting total attractor value assigned to the cell.
- h. The areas with high concentrations of cells with high values were identified. These high concentration areas identify existing and potential high cycling activity areas throughout the City.

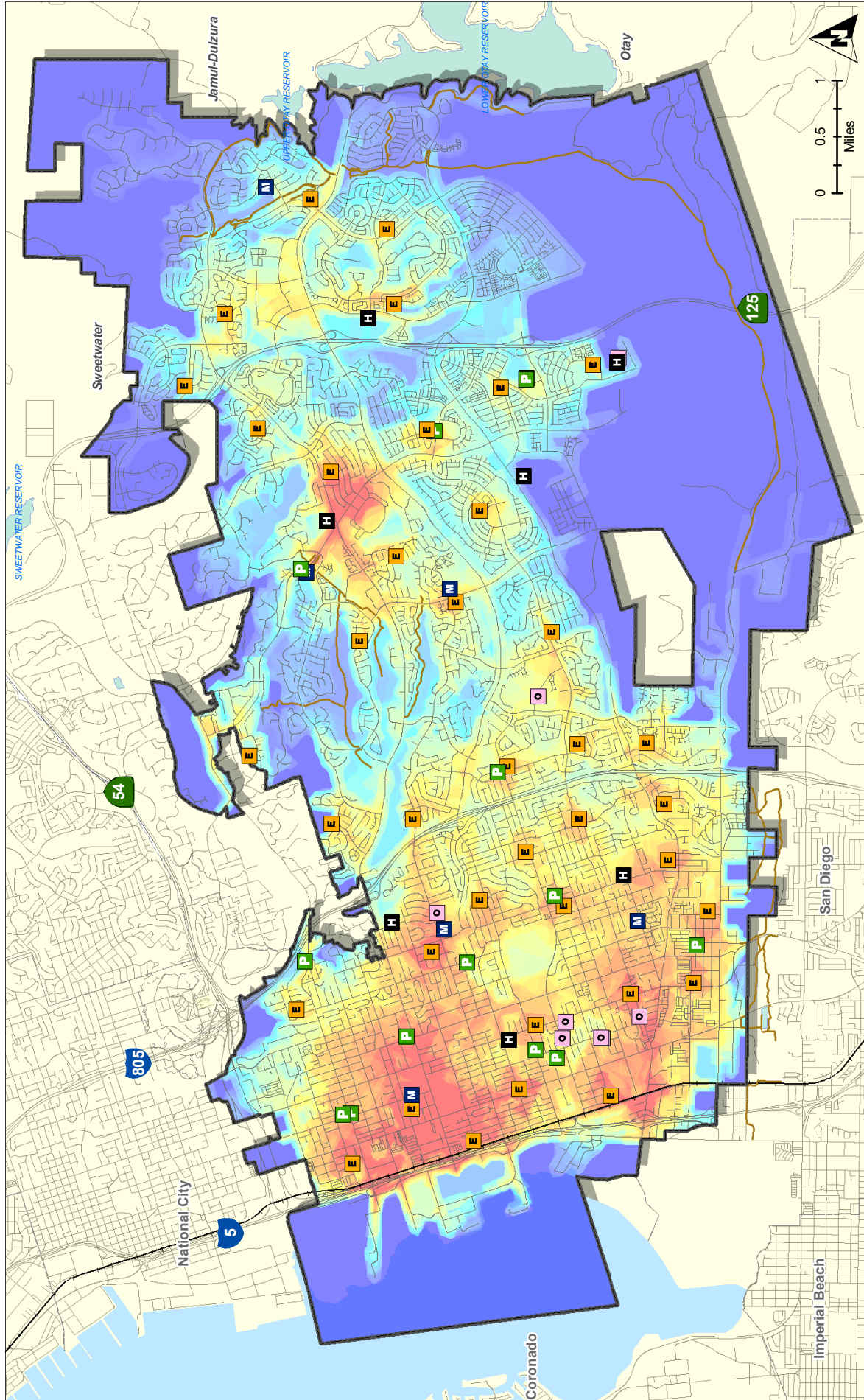
Cycling Attractors	Weighted Multiplier				
	Points	1/4 mile*	1/2 mile	3/4 mile	1 mile
High Volume Transit Stops (> 10,000 boardings and alightings per day)	4	6	4	3	2
Elementary Schools (Including Private)	4	6	4	3	2
Medium volume Transit Stops (1,000 - 10,000 boardings and alightings per day)	3	4.5	3	2.25	1.5
Middle Schools	3	4.5	3	2.25	1.5
Neighborhood Civic Facilities (Libraries, Post Office & Religious Facilities)	2	3	2	1.5	1
Neighborhood and Community Retail	2	3	2	1.5	1
Low volume Transit Stops (<1,000 boardings and alightings per day)	2	3	2	1.5	1
High Schools	2	3	2	1.5	1
Parks and Recreation (excludes non-useable open space)	1	1.5	1	0.75	0.5

\*1/4 mile = 1.5 x Points, 1/2 mile = 1 x points, 3/4 mile = .75 x points , 1 mile = .5 x points

## Cycling Generator Model Methodology

The Bicycle Suitability Model also utilizes demographic data as indicators of potential volume of cyclists based on how many people live or work within the cycling activity areas identified in the Attractor Model. This particular component is called the Generator Model. Existing and projected total population and employment were used, as well as other demographic data such as age and use of public transportation. The weighted multiplier scores were derived from City staff input, previous applications of the model and the factors that most influence bicycle trips within the City. Cycling activity areas that contain a greater number of people living or working within them were more likely to have more people cycling. The model uses SANDAG-defined pseudo-Census blocks called SANDAG Geographic Reference Areas (SGRAs) citywide and U.S. Census Bureau Census Block Groups. SANDAG Smart Growth Areas was also used to determine areas of potential development that could have high cycling activity due to their mixed land use criteria.

- a. The existing and future SGRA total population was divided by the SGRA area to determine existing and future population density.
- b. The existing and future SGRA total employment was divided by the SGRA area to determine existing and future employment density.
- c. The total population less than 16 years old was divided by the Census Block Group Area to determine the population density of these two age classes.



## Bicycle Suitability Model: Attractors

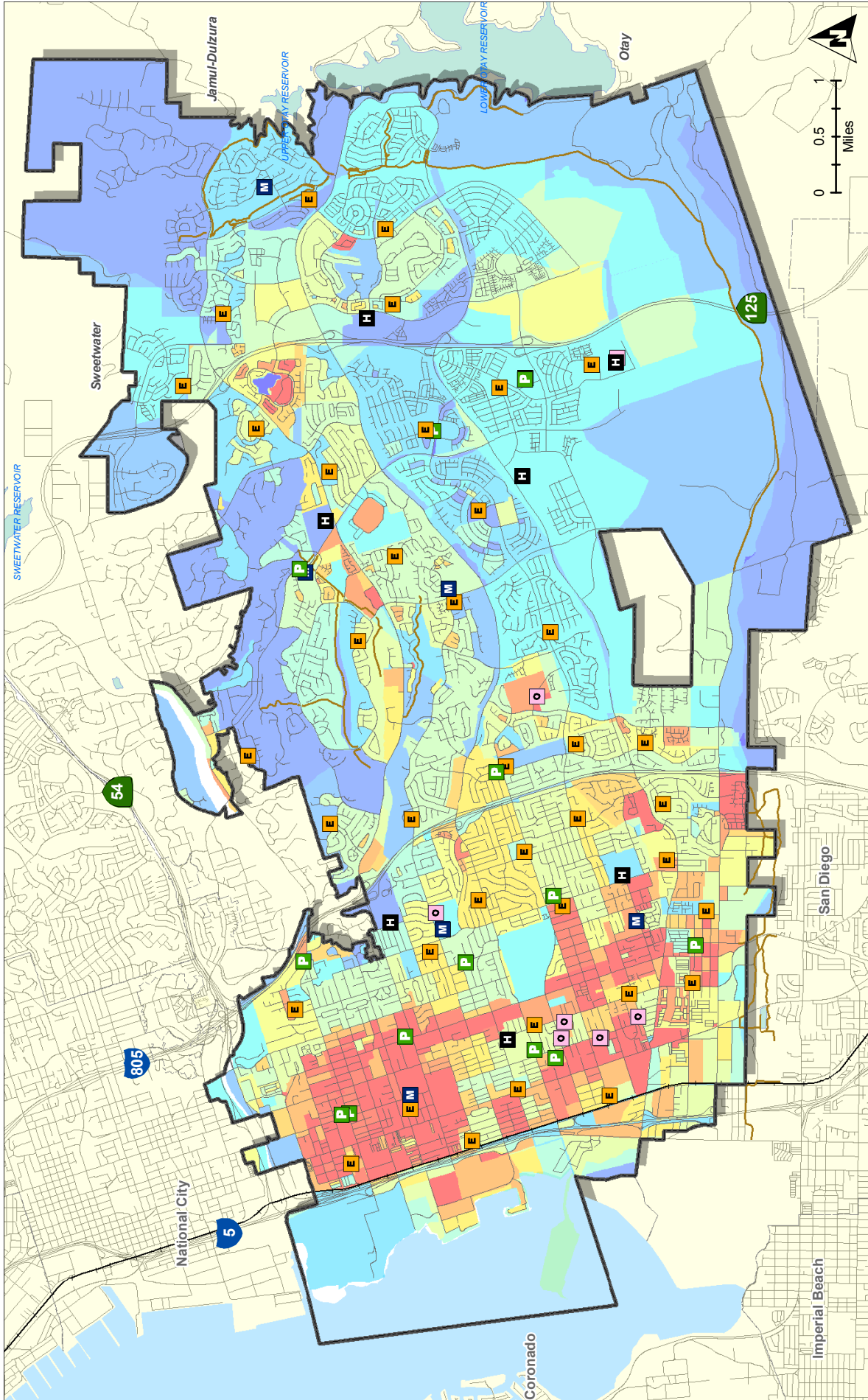


\* Source: KTU+A 2010  
 \*\* Source: SANDAG 2008

- d. The employment and population SGRA densities, as well as age densities, were categorized into density ranges and assigned points so that SGRAs with higher density ranges received higher initial points.
- e. Bike to Work Densities, Age Densities and Public Transportation Density were based on Census Block Group data from the Long Form from the year 2000 census.
- f. The age density and public transportation density points were overlaid to make a city-wide cell grid.

Cycling Generators	Points	Weighted Multiplier	Score
Cycling Mobility: People who bike to work* **			
> 4	3	3	9
2 - 4	2		6
< 2	1		3
Non-Vehicular Transportation: People who walk or use public transportation to work* **			
> 10	3	3	9
5 - 10	2		6
< 5	1		3
Population Density*			
> 20	4	2	8
10 - 20	3		6
5 - 10	2		4
1 - 5	1		2
Employment Density*			
> 40	3	2	6
20 - 40	2		4
< 20	1		2
Age Density: Children per acre (under 16 years old) **			
> 5	3	1	3
2 - 5	2		2
< 2	1		1
Household Income (Affects Transportation Options) **			
< \$34,500	3	1	3
\$34,500 - \$63,400	2		2
> \$63,400	1		1
Future Population Density ***			
> 25	3	2	6
5 - 25	2		4
1 - 5	1		2
Future Employment Density ***			
> 15	3	2	6
5 - 15	2		4
1 - 5	1		2
Smart Growth Areas ***			
Adopted Smart Growth Areas	2	1	2

\* People per acre, \*\* 2000 US Census Bureau, \*\*\* SANDAG



## Bicycle Suitability Model: Generators



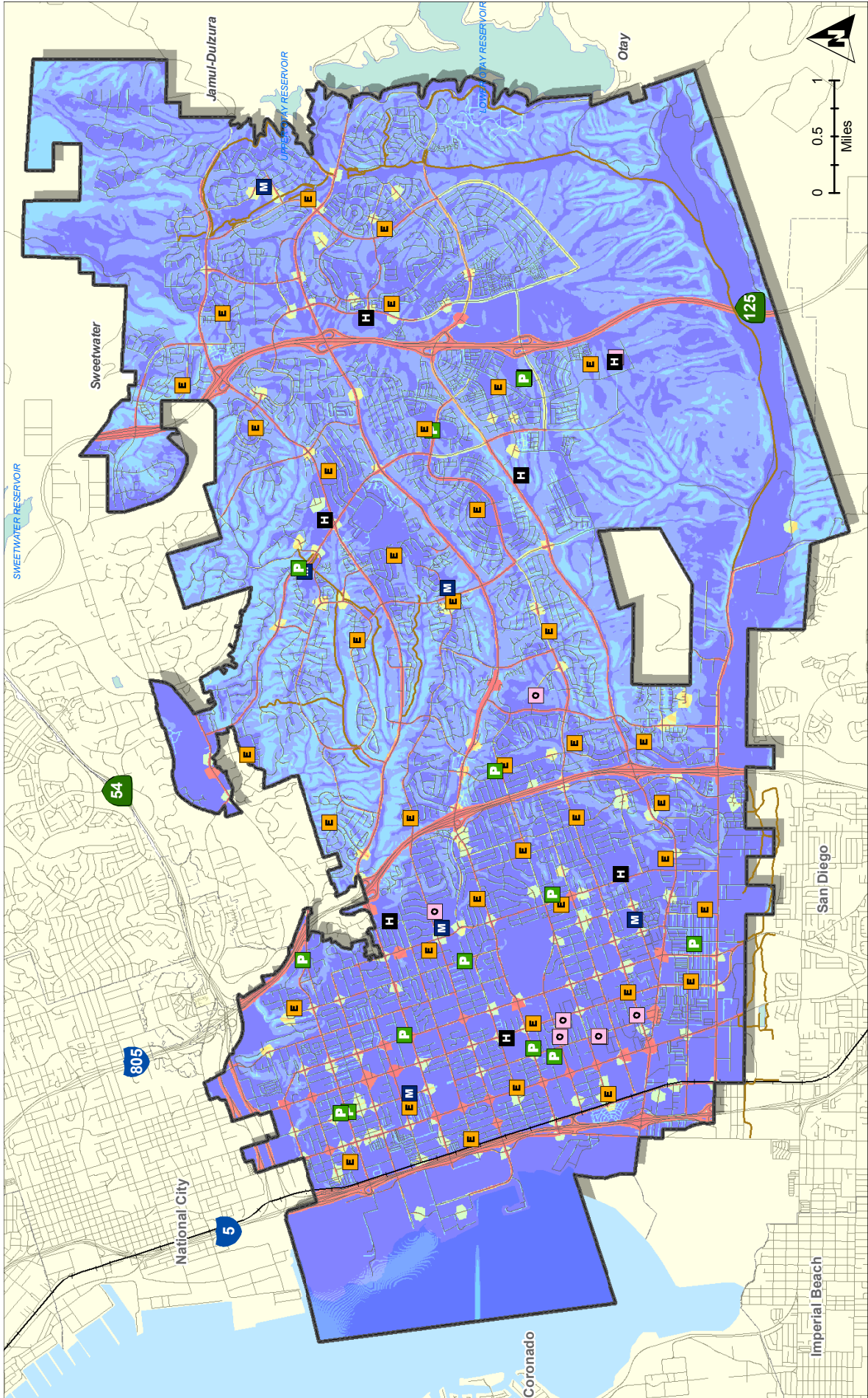
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## Cycling Detractor Model Methodology

Detractors are conditions that discourage or detract people from riding their bikes. Relevant factors are primarily related to vehicular volume and perceived safety of the cycling environment. Streets with high motor vehicle volumes and speeds tend to detract people from cycling. Known areas with a high level of bicycle-related collisions are also a deterrent since people may reroute their trip to avoid certain streets and intersections where safety may be a concern. The point system and weighted multipliers were derived from City staff input, public input through previous surveys, past applications of the model and available City data.

Cycling Detractors	Points	Weighted Multiplier	Score
Collisions Per Year *			
3	3	4	12
2	2		8
1	1		4
No collisions	0		0
Average Daily Trips as it Affects the amount of traffic congestion			
> 20,000	4	3	12
10,000 - 20,000	3		9
5,000-10,000	2		6
1,000 - 5,000	1		3
Freeway Barriers related to Cycling Travel			
	2	2	4
Speed as it Affects the perception of safety			
50+	3	1	3
25-45	2		2
< 25 mph	1		1
Slope & Canyons as Barriers to Cycling Travel			
Landform Feature with Slope > 25%	4	1	4
Landform or Street Slope 10-25%	3		3
Slopes < 10%	2		2
Exising Bicycle Facility Gaps			
	2	1	2

\* A 1/16 mile buffer was applied to each collision location.



Composite Bicycle Suitability Model: Detractors



\* Source: KTU+A 2010  
 \*\* Source: SANDAG 2008

## Composite Model

The Bicycle Suitability Model then combined the Generators, Attractors and Detractors.

- a. The Attractor, Generator and Detractor grid cell models were overlaid to produce the Bicycle Suitability Model.
- b. The combined grid cells that contain generators, attractors and detractors were added to provide a total composite value for each combined cell.
- c. The composite value identifies the areas that have a higher cycling activity point total.
- d. In some cases, the areas that have a high cycling activity score are areas that already have facilities, but further improvement can be made to enhance the cycling environment.

Refer to the following figure for the results of overlaying the four previous mapping efforts.

## Facility Prioritization Criteria and Implementation

The projects in this document are a combination of planned and recommended bicycle facilities. Since the planned projects have yet to be implemented, prioritizing them along with the recommended projects subjects all of them to the same priority and implementation criteria. These projects were then itemized into Prioritized Projects, which are those that will have a significant impact on the existing bikeway system, such as by closing major gaps, or extending or developing bike paths, lanes or routes along major transportation corridors.

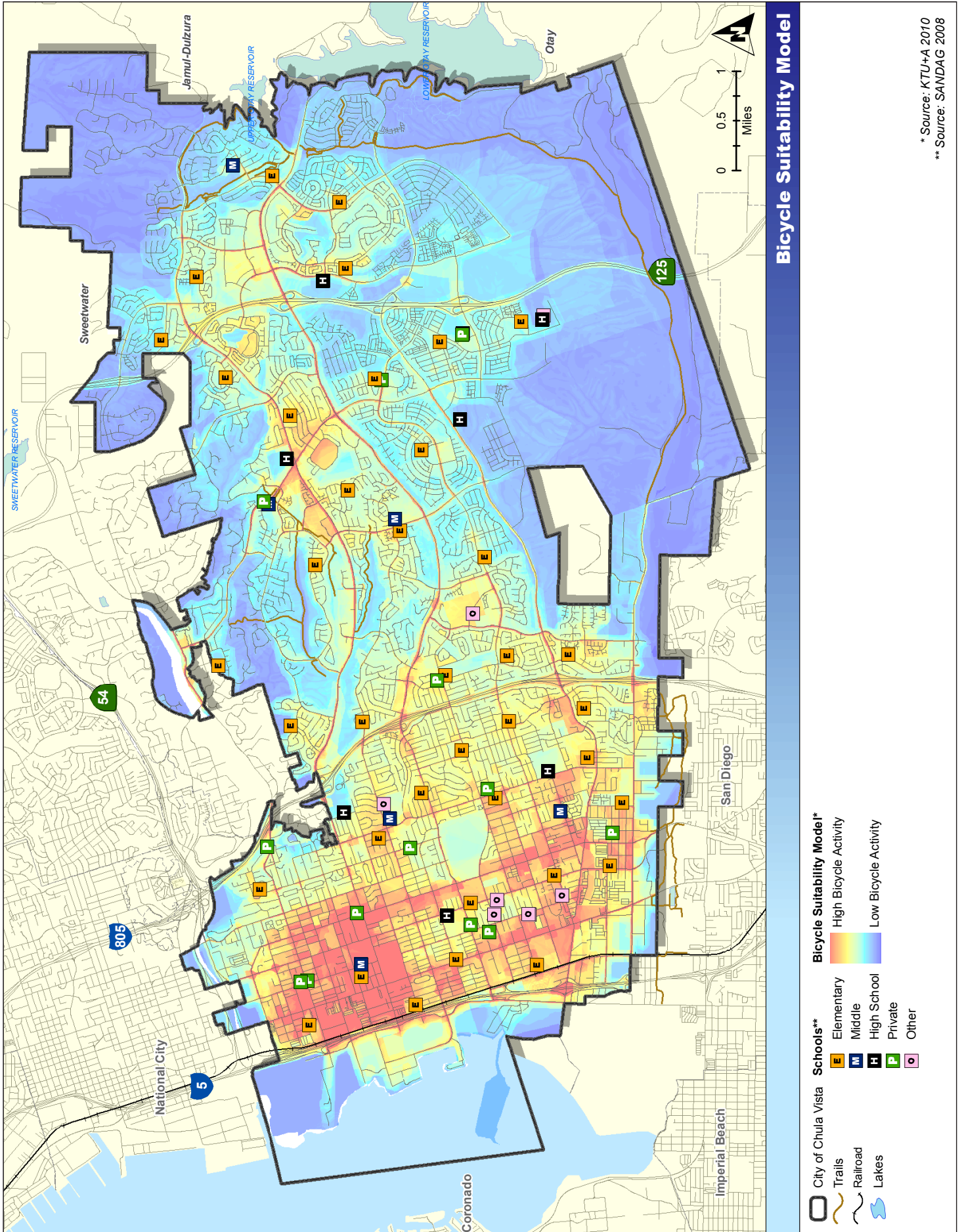
The following prioritization criteria were used to help identify which routes are likely to provide the most benefit to the City's bikeway system. The numbering used to identify projects within each bikeway facility class in the following sections does not necessarily imply priority. Bikeway facility implementation has no specific time line, since the availability of funds for implementation is variable and tied to the priorities of the City's capital improvement projects.

### Bicycle Suitability Model (total of 4 points)

The Bicycle Suitability Model acquires the routes total model score and is then divided by the acreage of that project. This technique normalizes the scores throughout all the projects. This allows projects with smaller footprints to have the same scoring parameters as larger projects. The breakdown in points is as follows:

#### 1. Scoring breakdown: 1 - 4 points

- High: >1,350 - 4
- Moderately high: 900-1,350 - 3
- Moderate: 450-900 - 2
- Low: <450 - 1



\* Source: KTU+A 2010  
 \*\* Source: SANDAG 2008

## **Mobility and Access (total of 9 points)**

### **2. Provides access to major bicycle traffic generators: 1 - 3 points**

- Provides access to areas of high bicycle traffic generation – 3  
(Ex: Project is over a mile long and travels through single family and/or multi-family residential and high employment densities such as office parks)
- Moderately access to areas of high bicycle traffic generation – 2  
(Ex: Project is less than a mile long and travels through or near single family residential, a school and moderate employment densities such as schools, commercial areas)
- Low access to areas of high bicycle traffic generation – 1  
(Ex: Project not near any residential land use and low to moderate employment densities)

### **3. Closes gap in significant route: 1 - 3 points**

- Closes a gap in an existing high bicycle traffic facility - 3
- Closes a gap in a non-existent high bicycle traffic facility - 2
- Closes a gap to connect facilities with little bicycle use - 1

### **4. Adequate access to activity centers, schools and transit sites: 1 – 3 points**

- Provides direct access to a major activity center, elementary school and/or transit center - 3
- Provides direct access to an activity center, middle and/or high school or bus stop - 2
- Route is not near an activity center, school and/or transit center but is important for connections- 1

## **Safety (total of 6 points)**

### **5. Improves locations where bicycle crashes have occurred: 1 - 3 points**

- Fatal collisions have occurred directly on this route - 3
- Injury and non-injury related bicycle collisions have occurred on or near this route - 2
- No collisions have occurred on this route - 1

### **6. Improves routes with high vehicular traffic volumes: 1 - 3 points**

- Improves routes with high average daily trips (>15,000) - 3
- Improves routes with moderate average daily trips (5,000-15,000) - 2
- Improves routes with low average daily trips (<5,000) - 1

## **Existing Conditions (total of 6 points)**

### **7. Route has a continuous bikeway: 1 – 3 points**

- The route has very few stop signs and/or is continuous on one street - 3
- The route has moderate stop signs and/or continues on no more than two to three streets - 2
- The route has many stops signs and/or continues along numerous streets - 1

### **8. Roadway able to accommodate bikeways: 1 – 3 points (Class 2 Only)**

- Roadway currently can accommodate the recommended facility with no construction and/or redesign – 3  
(Ex: Add striping and signage)
- Roadway can accommodate the recommended facility with minimal to moderate construction and/or redesign – 2  
(Ex: Median or curb removal or realignment, re-striping lanes, etc)
- Roadway will need extensive construction and/or redesign to accommodate the recommended facility – 1  
(Ex: Parking removal, sidewalk/planting strip removal and reinstallation, roadway realignment, utility re-alignment, etc.)

## Regional Significance (total of 6 points)

### 9. Route has regional significance in the bikeway system: 1 – 3 points

- High significance, connects major bicycle facilities and activity centers – 3

(Ex: Part of the SANDAG Regional Bike Plan network, connections to adjacent City's bicycle facilities)

- Moderate significance, connects some routes and activity centers – 2

(Ex: Important internal connections to regional routes and major activity centers, schools and colleges)

- Little significance, does not directly connect to activity centers, etc., but is still important in the bikeway system – 1

(Ex: Project travels through neighborhoods and makes connections to other facilities)

### 10. Route has aesthetic attributes: 1 – 3 points

- Majority of the route has significant aesthetic attributes, such as visible open space, waterway corridors, parks, beaches, etc. - 3

- Parts of the route has moderate aesthetic attributes, such as visible open space, waterway corridors, parks, beaches, etc. - 2

- Little to none of the route benefits from open space, waterway corridors, parks, beaches, etc. - 1

The maximum possible score is 31 points for Class 2 facilities and 28 for Class 1 and Class 3 facilities. Proposed projects can be rated periodically at whatever interval best fits funding cycles or to take into consideration the availability of new information, new funding sources, updated crash statistics, etc. Bike-way facility prioritization and implementation should be fine-tuned and adjusted accordingly based on future circumstances. The individual project scoring is shown in the following tables.

Recommended Class 1 Bike Paths													
Segment Number	Segment Location	Miles	Model Results	Model Score	Provides access to major bicycle traffic generators:	Closes gap in significant route:	Adequate access to activity centers and transit sites	Improves locations where bicycle crashes have occurred	Improves routes with high vehicular traffic volumes	Route has a continuous bikeway	Route has regional significance in the bikeway system	Route has aesthetic attributes	Score
<b>1</b>	Bay Blvd E Street to F Street	<b>0.25</b>	1,976	4	2	3	3	1	1	3	3	3	<b>23</b>
<b>2</b>	I-805 Corridor between Telegraph Canyon Road and City limit	<b>1.68</b>	1,100	3	2	3	3	1	1	3	3	3	<b>22</b>
<b>3</b>	Bay Blvd F Street to H Street	<b>0.51</b>	1,260	3	2	3	2	1	1	3	3	3	<b>21</b>
<b>4</b>	Bay Blvd H Street to Bayshore Bikeway/ Palomar Street	<b>1.71</b>	885	2	2	3	2	1	1	3	3	3	<b>20</b>
<b>5</b>	E Street to H Street	<b>1.22</b>	386	1	1	2	1	1	1	3	3	3	<b>16</b>
<b>6</b>	H Street to Bay Boulevard	<b>1.40</b>	446	1	1	2	1	1	1	3	3	3	<b>16</b>

Recommended Class 2 Bike Lanes															
Segment Number	Roadway Segment	Miles	Limits	Model Results	Model Score	Provides access to major bicycle traffic generators:	Closes gap in significant route:	Adequate access to activity centers and transit sites	Improves locations where bicycle crashes have occurred	Improves routes with high vehicular traffic volumes	Route has a continuous bikeway	Roadway able to accommodate bikeways	Route has regional significance in the bikeway system	Route has aesthetic attributes	Score
1	Main Street	2.89	I-5 to Main Court	299	1	3	3	3	2	3	3	3	3	1	25
2	Otay Lakes Road	0.30	Rutgers Avenue to end of existing westbound bike lanes	497	2	2	3	1	2	3	3	3	3	2	24
3	East H Street	0.57	End of bike lanes to Otay Lakes Road	1,140	3	2	3	3	2	3	2	1	3	1	23
4	Fourth Avenue	0.51	Main Street to City Limit	597	2	1	3	2	3	2	3	3	2	2	23
5	Otay Lakes Road	0.27	Elmhurst Street to Apache Drive	670	2	2	3	2	1	3	3	2	3	1	22
6	Heritage Road	0.27	Main Street to Entertainment Circle	190	1	1	2	3	1	2	3	3	3	3	22
7	Industrial Boulevard and L Street	0.94	Bay Boulevard to Palomar Street	1,479	4	2	1	3	2	2	1	3	2	1	21
8	Telegraph Canyon Road	0.25	Nacion Avenue to Halecrest Drive	800	2	2	3	2	2	3	1	2	3	1	21
9	East H Street	0.37	I-805 southbound on-ramp to existing bike lanes	758	2	2	3	2	2	3	1	2	3	1	21
10	Broadway	0.28	Main Street to City Limit	494	2	1	2	2	1	3	3	3	2	2	21
11	East J Street	0.70	River Ash Drive to Paseo Ranchero	1,071	3	2	3	1	2	2	1	2	3	1	20
12	East H Street	0.25	East of Otay Lakes Road to east of Auburn Avenue	695	2	2	3	1	1	3	3	1	3	1	20
13	Industrial Boulevard	0.50	Ada Street to Main Street	969	3	1	1	1	2	2	2	3	3	1	19
14	Santa Victoria Road	1.84	Olympic Parkway to Santa Venetia Street	170	1	3	1	1	1	1	2	2	3	3	18
15	Heritage Road	0.43	Olympic Parkway to Santa Victoria Road	145	1	1	1	1	1	1	3	3	3	3	18
16	Lake Crest Drive	0.88	Otay Lakes Road to Wueste Road	238	1	2	2	1	1	1	1	3	3	2	17

## Recommended Class 3 Bike Routes

Segment Number	Roadway Segment	Miles	Limits	Model Results	Model Score	Provides access to major bicycle traffic generators:	Closes gap in significant route:	Adequate access to activity centers and transit sites	Improves locations where bicycle crashes have occurred	Improves routes with high vehicular traffic volumes	Route has a continuous bikeway	Route has regional bikeway system significance	Route has aesthetic attributes	Score
<b>1</b>	Broadway	<b>4.16</b>	C Street to City limit	701	2	3	3	3	3	3	3	3	1	<b>24</b>
<b>2</b>	I Street	<b>2.17</b>	Colorado Avenue to Robert Avenue	1,395	4	3	2	3	3	2	3	2	1	<b>23</b>
<b>3</b>	Naples Street	<b>0.86</b>	Industrial Boulevard to Fourth Avenue	1,450	4	3	3	3	2	2	3	2	1	<b>23</b>
<b>4</b>	Third Avenue	<b>1.00</b>	East J Street to Naples Street	674	2	2	2	3	3	3	3	2	2	<b>22</b>
<b>5</b>	Fifth Avenue	<b>3.53</b>	City limit to Orange Avenue	1,137	3	3	2	3	3	2	3	2	1	<b>22</b>
<b>6</b>	Oxford Street and East Oxford Street	<b>2.44</b>	Industrial Boulevard to Melrose Avenue	1,333	3	3	2	3	2	2	3	3	1	<b>22</b>
<b>7</b>	Third Avenue	<b>1.50</b>	D Street to East J Street	918	3	2	2	3	3	2	3	2	1	<b>21</b>
<b>8</b>	Third Avenue	<b>0.39</b>	C Street to D Street	1,019	3	3	2	2	3	2	3	1	1	<b>20</b>
<b>9</b>	Melrose Avenue	<b>2.59</b>	Telegraph Canyon Road to Main Street	886	2	3	2	3	2	1	3	2	1	<b>19</b>
<b>10</b>	Oleander Avenue, Lori Lane and Crest Drive	<b>3.07</b>	East J Street and Main Street	736	2	3	2	3	2	1	2	2	2	<b>19</b>
<b>11</b>	Flower Street and First Avenue	<b>0.79</b>	First Street Street to Bonita Road	665	2	3	1	3	3	1	2	2	1	<b>18</b>
<b>12</b>	Mackenzie Creek	<b>1.35</b>	Mt. Miguel Road to Lane Avenue	800	2	3	2	3	1	1	3	2	1	<b>18</b>
<b>13</b>	Woods Drive, Stone Gate Street, Northwoods Drive, Adirondack Place and Duncan Ranch Road	<b>2.00</b>	Proctor Valley Road and Hunte Parkway to Otay Lakes Road	521	2	3	2	3	2	1	1	2	2	<b>18</b>

Recommended Class 3 Bike Routes														
Segment Number	Roadway Segment	Miles	Limits	Model Results	Model Score	Provides access to major bicycle traffic generators:	Closes gap in significant route:	Adequate access to activity centers and transit sites	Improves locations where bicycle crashes have occurred	Improves routes with high vehicular traffic volumes	Route has a continuous bikeway	Route has regional bikeway system significance	Route has aesthetic attributes	Score
14	Santa Venetia Street	0.70	Olympic Parkway to Magdalena Avenue	341	1	2	3	3	2	1	3	2	1	18
15	Albany Avenue	0.46	East Orange Avenue to Main Street	737	2	3	1	3	1	1	3	2	1	17
16	East San Miguel Drive, Cuyamaca Avenue and Guatay Avenue	0.98	Vista Way to Hilltop Drive	401	1	3	1	3	1	1	2	2	1	15
17	Max Avenue, Malta Avenue and Slate Street	0.81	East Orange Avenue to Melrose Avenue	342	1	3	1	3	1	1	2	2	1	15
18	Gotham Street, Creekwood Way and Chateau Court	0.53	Rutgers Avenue, Creekwood Way and Chateau Court	425	1	3	2	3	1	1	2	1	1	15
19	East Rienstra Street and Nacion Avenue	1.69	East L Street/Telegraph Canyon Road to Melrose Avenue	816	2	3	1	1	2	1	2	1	2	15
20	Allen School Lane	0.32	Otay Lakes Road to Allen Elementary School	455	2	2	1	3	1	1	3	1	1	15
21	Oak Springs Drive	0.22	Silver Springs Drive to South Creekside Drive	643	2	2	2	1	2	1	3	1	1	15
22	Hidden Vista Drive, Smoky Circle and Bayleaf Drive	0.65	Terra Nova to City Limits	599	2	2	2	3	1	1	1	2	1	15
23	Santa Rosa and Santa Paula Drives	1.04	Otay Lakes Road to East Palomar Street	369	1	3	1	1	1	1	2	1	1	12
24	State Street	0.19	Santa Victoria Road to La Media Road	190	1	1	1	1	1	1	3	1	1	11

